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Analyses of Natural Convection Heat Transfer from a Heated Cylinder Mounted in Vertical Duct

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Abstract : Experiments are conducted to analyze the steady-state and the power-on transient natural convection heat transfer from a horizontal cylinder mounted in a vertical up flow circular duct. The heat flux ranges from 177 W/m² to 2426 W/m² and the Rayleigh number ranges from 1×10⁴ to 4.35×10⁴. For natural air flow and constant heat flux condition, the effects of heat transfer around the cylinder under steady-state condition are investigated. The steady-state results compare favorably with that of the available data. The effects of transient heat transfer data on different angular position of the thermocouple (0°, 90°, 180°) are also reported. It is observed that the transient heat transfer around the cylinder is strongly affected by the position of thermocouples. In the transient region, the rate of heat transfer obtained at 90° and 180° are higher than that of stagnation point (0°). Finally, the dependence of the average Nusselt number on Rayleigh number for steady and transient natural convection heat transfer are analyzed, and a correlation equation is presented.

Keywords : Fourier number, Nusselt number, Rayleigh number, steady state, transient
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